DOCUMENT RESUME

ED 244 675 JC 840 264

AUTHOR McQuay, Paul L.
TITLE Automated Manufacturing/Robotics Technology: Certificate and Associate Degree Programs.
INSTITUTION Delaware County Community Coll., Media, Pa.
PUB DATE 84
NOTE 28p.
PUB TYPE Reports - Descriptive (141)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Automation; Course Descriptions; Course Objectives; *Curriculum Development; *Electromechanical Technology; Minimum Competencies; Program Costs; Program Proposals; *Technical Education
IDENTIFIERS *Robotics

ABSTRACT

A description is provided of the Automated Manufacturing/Robotics program to be offered at Delaware County Community College beginning in September 1984. Section I provides information on the use of reprogramable industrial robots in manufacturing and the rapid changes in production that can be effected through the application of automated technology. This section also identifies the fields open to a person trained in automation/robotics and the competencies to be possessed by program graduates. Section II underscores the need for the program, providing a job market analysis; salary information; a discussion of short- and long-term, national and local employment outlooks; and a list of potential employers in the Delaware Valley. Section III begins with a list of the members of the program advisory committee, and then provides a discussion of the development and content of the curriculum, identifies the target population, and notes the approval of course competencies. Section IV provides information on program implementation, covering equipment needed to initiate the program, curriculum development costs, operating costs, and enrollment. Appendices provide descriptions of five courses in the program: Numerical Control I and II, Robotics I and II, and Electro/Mechanical Systems. Competencies are listed for each course. (HB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED244675

AUTOMATED MANUFACTURING/ROBOTICS TECHNOLOGY

(Certificate and Associate Degree Programs)

The Division of Applied Science

Delaware County Community College

Media, PA 19063

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

P. McQuay

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

✓ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

JC 840 264

Person Responsible: Paul L. McQuay
Dean, Applied Science

1984

PREFACE

The following document, Automated Manufacturing/Robotics was approved in total by the Curriculum Affairs Committee of Delaware County Community College in Media, Pennsylvania, in November of 1983, and by the Board of Trustees of the College in January 1984. The Automated Manufacturing/Robotics Program will be available on a full- or part-time day or evening basis beginning in September, 1984.

Table of Contents

AUTOMATED MANUFACTURING/ROBOTICS

		Page
I.	Program Description	
	A. Program Competencies	1
II.	Need for the Program	
	A. Job Market Analysis	4
	B. Salaries	5
	C. Short and Long-Term Outlook	5
	D. Potential Delaware Valley Employers	8
III.	Program	
	A. Advisory Committee	10
	B. Curriculum Development	11
	C. Curriculum	13
	D. Course Competencies	14
	E. Target Population	14
IV.	Implementation	
	A. Cost of the Program	15
	B. List of Equipment for Program Initiation	15
	C. Curriculum Development/Support Material Costs	18
	D. Operating Costs	18
	E. Enrollment	18
V.	Appendix A	20

AUTOMATED MANUFACTURING /ROBOTICS TECHNOLOGY CURRICULUM

I. PROGRAM DESCRIPTION

The integration of state of the art technology inherent to reprogrammable industrial robots with knowledge intensive systems such as computer assisted design, computer assisted manufacturing, computer controlled machine tools, automated transfer lines and automated inspection equipment has provided today's manufacturers with a cost effective approach to automation. Flexibility of an automated system is imperative if a manufacturer intends to fully meet the changing demands imposed on product lines by the consumer.

Rapid changes in process control, product design and production scheduling can be effected through the application of today's automated technology. The proposed Automated Manufacturing/Robotics program has been developed to provide individuals with a broad base of marketable entry level skills and knowledge related to the field of automated manufacturing. Direct emphasis for this curriculum is placed on the aspects of integration of reprogrammable automated multi-functional machine tools, robots, and material handling systems.

The structure of the curriculum is such that basic skills and knowledge are highly transferrable. Thus, the graduate of this program is provided with a good background for upward career mobility within the field of automation/robotics, as well as in parallel fields of employment requiring individuals who possess an electromechanical background.

Depending on the employer, job level and job description, an automation/robotics technician's job responsibilities may include assisting engineers in the design and application of automated equipment. The

automated manufacturing/robotics technician may be responsible for coordinating installation of new equipment, while others would be responsible for preventative maintenance, scheduling and integrating automated systems. Some technicians would specialize in specific components of automated equipment such as machine tools, while others would specialize in transfer equipment. Others may choose to seek additional education and specialize in logic systems design, or in interfacing of control mechanisms with monitoring and feedback devices for total system operation. Efforts of concentration may be expended by others in the areas of programming microprocessor/computer based equipment which direct and monitor a machine tool, transfer line, process, or total system. Automated manufacturing /robotics technicians will find employment in industries and commercial establishments involved with various phases of product manufacturing or processing which include; automated machining, machine loading and unloading, inspection of parts, welding, die casting, forging, heat treating, painting, palletizing, assembly and materials handling. Additionally, technicians with backgrounds similar to those developed from the experiences provided in the proposed curriculum, may secure employment with a robot manufacturer, or distributor, as a technical representative in sales and marketing. Other job opportunities with establishments of this nature include assembler, inspector, installer, trouble-shooter, and service technician/engineer. Future positions for graduates of the program are assured by research currently being undertaken by the Federal government, by universities and private research institutions. On-going research in automation deals with the application of leading edge technology to modify and enhance machine tools, robots, computers, transfer and other peripheral equipment associated with automated

manufacturing. Research of this nature is being conducted in the areas of tactile sensing, vision systems, work cell enhancement and end-of-arm tooling development for robots.

A. Program Competencies

Upon completion of this program, the student should be able to:

1. prepare manual and computer assisted programs for directing the operation of numerically controlled machine tools.
2. describe the structural and functional characteristics of various types of robots.
3. define accident prevention procedures associated with the operation of automated equipment.
4. explain the aspects of flexibility associated with computerized automation systems.
5. identify methods and equipment needed to integrate automatic inspection and gaging processes within a robotic work cell or automated system.
6. integrate automated materials handling, assembly, manufacturing and transfer equipment.

II. NEED FOR THE PROGRAM

Futuristic magazine (June '83) in an article entitled "Getting Ready for Jobs of the Future" reports that over the next two decades, job openings in "computamation (robotics, numerically-controlled equipment, CAD/CAM computer-aided design and computer-aided manufacturing, and flexible manufacturing) will range from 300,000 in CAD, and 300,000 in CAM, to 800,000 in robotics alone."

A direct correlation exists between expected job openings in the field of factory automated equipment and the projected market for factory automation equipment. Metal Fabricating News (Sept.-Oct. '83) in an article entitled "Robots Lead Surge" reports that Predicast, Inc., a Cleveland based business information and market research firm sees the introduction of CAD/CAM systems and robots to the factory automation market as a boom for the market. The boom will last well into the 1990's, stimulating the market with a growth rate of 15.2% per year between 1982 and 1987, creating a $15 billion market, it is expected that sales of automated equipment will be over $37 billion by 1995. A recent edition of the Kiplinger Washington Letter (Dec. 23, 1982) notes that the best job opportunities through 1990 will be found in the jobs related to computers. State of the art technology permits integration of computer driven automation systems, robots, and machine tools. The Letter reports that ". . . the market for robots will double every three years on the average, . . . through 1990."

In the May 11, 1983 edition of Focus, in an article entitled, "Robotics is Changing the Way for Industry," George S. Crosby, President of U.S. Robots, a King of Prussia, PA. based firm, indicates that his company "is looking at $1 billion in sales in the immediate future."

A. Job Market Analysis

Employment in the field of Automated Manufacturing/Robotics is projected to grow at least as fast as the average for all occupations through the 1980's and may well be a leader in the 1990's. Employment in the field will be spurred by the rate of expanded utilization of computer driven numerical machine tools, equipment, and robots in the work place. Through the early 1990's it is estimated that nationally, 800,000 plus job openings will become

available in the CAM., electromechanical automation, and robotics fields. These figures could increase if the economy were to gain a more positive momentum.

The Automated Manufacturing/Robotics technology program offers an Associate of Applied Science Degree, and a Certificate of Competency. Thus, preparing graduates with those skills required for entry level technical employment.

B. Salary

Average earnings, on a national basis, for technicians possessing electromechanical, and precision machining backgrounds in 1980 was 9 to 11 dollars an hour.

A recent survey of local employers projects the salary range and average salary to be:

Starting Salary	Average Starting Salary
$13,000 - $17,000	$15,000

C. Short and Long-term Outlook - Locally and Nationally

The Occupational Outlook Handbook offers the following national perspective for the short and long term outlook in the field of automated manufacturing:

> Employment of technicians involved with Automated/ Manufacturing/Robotics is expected to increase as fast if not faster than the average rate for all occupations through the 1980's. An increase in the number of individuals in the consumer age group most responsible for purchase of large price tag items is expected to stimulate demand for buildings, automobiles, heavy machinery, appliances, and thousands of other products produced via automated processes. The rate of expansion in the industries that produce these goods will determine the actual increase in the number of Automated Manufacturing/Robotics technicians.

In addition, increased complexity of modern technology underlines the anticipated increase in demand for technicians; "...many will be needed to work with the growing number of engineers and scientists in developing, producing, and distributing new and technically advanced products. Likewise, many jobs will arise as present technicians transfer to other occupations, retire, or die."

Job opportunities in the 1980's will reflect cyclical swings in the economy. During recessions, a decline in research and development funds, new product designs, and other expenditures result in less demand for the skilled technician. Job prospects for automated manufacturing/robotics technicians will also vary markedly by geographical region, demand will be strong in the sunbelt, mid, and western states in particular.

On the local level, employers contacted were hesitant to project figures on job openings because of the current economic state of manufacturing; however, of those surveyed, most felt that jobs in automation and Computer Numerical Control (CNC) machining would increase as the economy swings upwards. A few comments follow:

"Our company is in the planning stages of incorporating automated assembly equipment (to include robots) into our production facilities--as the economy brightens, and product demand quickens, we will begin implementation."

"Studies show that retrofitting numerical control equipment with updated programmable controllers is cost effective...we need qualified people to perform retrofits."

"Our people simply do not have the skills to work on the newer pieces of equipment."

"Pneumatics, hydraulics, encoders, resolvers, computers are the coming thing, industry certainly needs qualified personnel to handle all phases."

"The cost of in-house training is prohibitive for these types of people."

"Companies like mine are willing to send employees to learn about the new pieces of equipment being purchased but, our people do not possess a background in today's technology, so we are struggling to catch-up."

"Our robots perform hot jobs, jobs that most people don't like (die casting work) but we still need people to keep them operating."

"A fully automated factory is not too far in the future, a stimulating economy will move us off-center in this regard."

D. Potential Employers (Delaware Valley)

Ace Welding Service, Inc.
4250 Torresdale Avenue
Philadelphia, PA 19124

Boeing Vertol Co.
P.O.Box 16858
Philadelphia, PA 19142

Bell Telephone Labs
Cransford Corner Road
Holmdel, New Jersey 07733

Burroughs Corp.
P.O.Box 203
Paoli, PA 19301

Campbell Soup Co.
Campbell Place
Camden, New Jersey 08101

Control Data Corp.
2621 Van Buren Avenue
Norristown, PA 19403

Doehler-Jarvis/Farley, Ind., Inc.
P.O.Box 318
Pottstown, PA 19464

Eastern Conveyor Co., Inc.
4345 Orchard St.,
Philadelphia, PA 19121

Eastern Packaging Co.
635 Rhawn Street
Philadelphia, PA 19111

Fairmount Foundry, Inc.
P.O.Box 66
Front and Pine Street
Hamburg, PA 19526

Inoll, Inc.
349 W. Lancaster Avenue
Haverford, PA 19041

Jade Corporation
1120 Industrial Hwy.,
Southampton, PA 18966

Keystone Automated Eq. Co.
4661 Torresdale Avenue
Philadelphia, PA 19124

Kulicke & Soffa, Inc.
507 Prudential Road
Horsham, PA 19044

Lansdowne Steel Co.
Highland Avenue & Alpha Terrace
Morton, PA 19070

Mc Fatridge & Son
1141 N. Easton Road
Willow Grove, PA 19090

McNeil Consumer Product
Camp HIll Road
Ft. Washington, PA 19034

Metal Forms
Box 281
Phoenixville, PA 19460

Nordson Corp.
920 Madison Avenue
Norristown, PA 19401

Packaging Systems Corp.
9 Union Avenue
Bala Cynwyd, PA 19004

Penn-Field Industries, Inc.
P.O.Box 31
420 Station Road
Quakertown, PA 18951

Production Welding, Inc.
7725 Bingham Street
Philadelphia, PA 15203

Proven Products, Inc.
237 Jacksonville Road
Hatoboro, PA 19040

Rollins Environmental Services, Inc.
U.S. Hwy. #322
Swedesboro, New Jersey 08085

Sensor Electronics, Inc.
105 Fairway Terrace
Mt. Laurel, New Jersey 08054

Sperry Corp.
P.O.Box 500
Blue Bell, PA 19424

Snythicom, Inc.
146 W. Black Horse Pike
W. Collingswood Heights, N.J. 08059

S.P.S. Technologies
Highland Avenue
Jenkintown, PA 19046

S.P.S. Technologies
Township Lane Road
Hatfield, PA 19440

Terumo Medical Corp.,
P.O.Box 605
Elkton, MD 21921

Todd Steel Pickling
8451 Hegerman Street
Philadelphia, PA 19136

Westinghouse International
Power Generation & Operations Division
Lester, PA 19113

Wyeth Laboratories
611 E. Nield Street
West Chester, PA 19380

Yarway Corporation
Narcissus Road
Blue Bell, PA 19422

Unique Machine Co.
Montgomeryville Industrial Park
Montgomeryville, PA 18936

United States Machine Works, Inc.
21 Williams Place
Lansdale, PA 19446

Vandor Manufacturing, Inc.
Edison-Furlong Road
Furlong, PA 18925

Wamar Industries, Inc.
1435 Pottstown Pike
West Chester, PA 19380

The Wheaton Co.
998 Easton Road
Warrington, PA 18976

William Force Co., Inc.
120 E. 7th Avenue
Conshohocken, PA 19428

Threshold Technology, Inc.
1829 Underwood Blvd.,
Delran, New Jersey 08075

III. PROGRAM

A. AUTOMATED MANUFACTURING/ROBOTICS ADVISORY COMMITTEE

Glenn L. Artman
Applied Sciences
Delaware County Community College
Media, PA 19063
353-5400, Ext. 296

Assistant Professor

Donald Day
W.F. Shipley Machinery Co.
280 N. Providence Road
P.O. Box 524
Media, PA 19063
565-2300

Sales Engineer
Unimation Corp. - Puma Robots
Westinghouse Corp. Robots

Geoffrey (Jeff) L. Howland
McNeil Consumer Products
Fort Washington, PA 19034
233-7382

Manufacturing Engineer

Kenneth Kirk
Sperry Corporation
P.O. Box 500
Blue Bell, PA 19424
542-6193

Principal Electrical Engineer
Advanced Testing and Technology Group

Steve Patterson
917 Harper Avenue
Drexel Hill, PA 19026
449-8235 (H)

Senior Engineer
Power Generation & Operations Division
Retrofit of NC/CNC Systems & Consultant
Westinghouse International
Lester, PA 19113 237-3199

Joseph Philips
Yarway Corporation
Narcissus Road
Blue Bell, PA 19422
825-2100

Project Engineer
Justification of Automation Systems

Lloyd Shepps
Boeing Computer Services Company
Scott Plaza #2
Industrial Highway
Philadelphia, PA 19113
522-3036

CAD/CAM Manager
Vertol Support Division

B. CURRICULUM DEVELOPMENT

The Automated Manufacturing/Robotics technology program is being developed in an effort to provide industry with individuals who possess an educational background in the functional and operational characteristics of state of the art numerical control and electromechanical components and mechanisms. Technicians possessing this background will meet the needs of employers who find that installation, operation, and maintenance of modern equipment requires knowledge and skills current work forces do not possess. With this thought in mind, the structure of the program will be such that it will be attainable to full-time, part-time, day and evening students. The majority of courses presently exist. Five new courses would be developed for the program.

The curriculum as described on page thirteen lists the required courses. The scheme for this program has been derived from advisory committee input, as well as a fairly extensive review of the literature (including materials from the Society of Manufacturing Engineers (SME) and the Robotics International (R.I.) affiliate of same). A review of similar and related programs at other community colleges and private sector educational service organizations as well as national occupational/vocational boards was also conducted. The following is a partial list of organizations whose programs were reviewed;

High Technology Training Center -
Lorain County, PA - Jobs Training Program

Advanced Training Systems
Murrysville, PA

The American Vocational Association
Washington, D.C.

Gulf Coast Community College
Panama City, Florida

Department of Employment and Training
Warren City, Michigan

IBM Corporation
Boca Raton, Florida

Mott Community College
Flint, Michigan

C. AUTOMATED MANUFACTURING/ROBOTICS TECHNOLOGY CURRICULUM

FIRST SEMESTER

SUBJECT	CREDIT HOURS	LECTURE	LAB
Technical Mathematics I (MAT 110)**	4	4	
English Composition I (ENG 100)*	3	3	
Technical Drawing (TEC 124)*	3	1	4
Manufacturing Processes I (TME 121)*	2	1	2
Basic Technical Skills (TEC 115)	3	1	4
	15	10	10

SECOND SEMESTER

Technical Mathematics II (MAT 111)**	4	4	
English Composition II (ENG 112)	3	3	
Computers in Problem Solving (MAT 135)*	3		
Electric Circuits (TEL 101)*	4	3	2
(+) Numerical Control I* (TME 100)	3	3	
	17	13	2

THIRD SEMESTER

Social Science Elective	3	3	
Technical Physics I (PHY 100)*	3	2	2
Electronics I (TEL 110)	4	3	2
(+) Numerical Control II (TME 101)	3	2	2
(+) Robotics I* (TME 200)	3	3	
	16	13	6

FOURTH SEMESTER

Humanities Elective	3	3	
Fluid Mechanics (TME 229)	4	3	2
(+) Electro/Mechanical Systems (TEL 200)	3	2	2
(+) Robotics II (TME 201)	3	2	2
Speech Communication (SPE 100)	3	3	
	16	13	6

\+ New courses

* Required for Certificate of Competency

** MAT 140, 141 or 160, 161 may be elected

D. COURSE COMPETENCIES

A course description and competencies for the five proposed courses in this program have been reviewed and approved by the advisory committee. These courses include: Numerical Control I and II, Robotics I and II, and Electro/Mechanical Systems. The new course descriptions and competencies are included in Appendix A.

E. TARGET POPULATION

The Automated Manufacturing/Robotics Technology program has been developed to enhance the offerings of Delaware County Community College in the technical areas ... areas of preparation for new and existing jobs. The Automated Manufacturing/Robotics Technology program is designed to prepare students for entry level employment or to upgrade existing skills. Course offerings are designed to provide the student with basic technical skills, as well as a general overview of the field of automation, robotics, and numerically controlled manufacturing machinery.

The lectures and laboratory experiences offered as part of this program will provide the student with an understanding and experience in numerical and computerized numerical control, programming techniques, and interfacing of electro/mechanical devices. Possession of skills and knowledge in these areas is mandatory for the installation, operation, and maintenance of a numerically-controlled automation or robotic system. Successful completion of the two-year program would lead to the awarding of the Associate in Applied Science degree. A student can earn a Certificate of Competency in Automated Manufacturing/Robotics by completing 32 credits.

Additional features of the program include:

. . .available on a full or part-time basis, day or evening courses.

. . .part of the articulation program with the secondary vo-tech system.

. . .part of the career ladder concept in the AGE Program (an intergenerational, technical studies program, in cooperation with other educational institutions).

. . .program is structured in a manner as to be flexible enough to adapt to rapid technological change.

IV. IMPLEMENTATION

A. COST OF THE PROGRAM

The cost of the proposed Automated Manufacturing/Robotics Technology program would be consistent with the cost of operating other technology programs offered by the College. Very little cost would be realized for facility development. Areas within the College have already been set aside for development of this program. The rooms involved will require only minor renovation as equipment is purchased for installation. These rooms and functions are as indicated below:

Function	Room
. Primary advanced technology laboratory for computer-aided manufacturing, computer numerical control, robotics and mechanical systems	A-121
. Interactive graphics - computer-aided drafting and design	A-123

Much of the existing manufacturing equipment currently being used to support on-going programs and courses will be utilized for courses in this curriculum. The electricity and electronics courses will be taught in the electronics laboratory.

B. LIST OF EQUIPMENT FOR PROGRAM INITIATION

In an effort to support the cost of equipping the proposed program, the Division of Applied Sciences has solicited vocational funding unsuccessfully. However, proposals for grant solicitation will be forthcoming, as a renewed

effort to fund equipment needs via grants is undertaken. In addition to soliciting vocational monies, grants will be requested from industry, foundations, and associations.

Until funding of this nature can be realized, an alternate plan for providing instruction has been devised. Under this plan, an agreement for shared utilization of numerical control equipment with the Delaware County Area Vocational-Technical School at Folcroft will be established. Likewise, the use of field trips to industry will be employed. Furthermore, student attendance at local association sponsored technical seminars will be required. On-site installation and use of vendor's demonstration equipment will be actively pursued.

1. Ideally, the following list of equipment is essential to operation of the program. If this equipment were available, extensive classroom instruction in the areas of computer-assisted machining and robot manipulation could be given. This equipment would also be utilized in the completion of experiments and laboratory projects. Instructional vehicles of this nature would give the student actual hands-on experience necessary to interface sensory and metrological devices with a robot or numerically controlled machine tool.

   The list of required equipment is as follows:

Computer Numerical Control (Milling)

. Three axis vertical machine including tool package	$35,000
. Tape reader	2,500
. Teletype	3,500
. Computer-aided manufacturing system/with plotter	16,000
. Staff development	1,000
. Curriculum development	5,000
. Machine tools	5,000
. Shipping and installation	1,000
	$69,000

Robotics

. Basic robot	$60,000
. Curriculum development	5,000
. Staff development	2,500
. Shipping and installation	1,000
. Tools	2,000
	$70,500

Computer Assisted Machine Turning

. Machining center with tooling	$11,500
. Curriculum development	1,000
. Staff development	1,000
	$13,500

Sensory Circuit Design and Application Systems
(allied to integration of CAM/Robotics)

. Transducers and instrumentation kit	$ 5,000
. Microprocessor applications trainer-w/modules	5,000
. Electrohydraulic and pneumatic system trainer	24,000
. Shipping and installation	1,000
. Tools	1,000
	$36,000

Electromechanical Servomechanisms Trainer(s)

. Servomechanism Trainer I	$ 3,176
. Servomechanism Trainer II	5,720
. Shipping	104
	$9,000

TOTAL	$198,000

C. CURRICULUM DEVELOPMENT COSTS

Costs incurred for the development of competencies, objectives, course outlines, laboratory projects, identification of teaching materials, textbook selection process, etc. for five proposed courses, to be completed over a two-year period.

$2,000

Purchase or development of audio-visual materials for classroom/laboratory use.

$2,000

TOTAL $4,000

D. OPERATING COSTS

After the initial year of the program, enrollments should be sufficient to generate revenue to cover programmatic costs with a small surplus returned to the school.

E. ENROLLMENT

The computer integrated NC/Automation Industry is rapidly emerging as the upsurge in manufacture and utilization of robots and related automation equipment gains momentum. The need for technicians to operate and support the equipment is also increasing. This growth rate should reflect a gradual increase in program enrollees until current average technical program enrollment figures are reached. The first year enrollment figure for this program will be small. This figure should be about 10 students. The second year target will be about 25-30 students total, full-time and part-time. Eventually, average program enrollment will be determined by job openings and individual career interests.

If this program can meet with all the necessary approvals in a timely manner, an extensive advertising campaign can be conducted to notify the public of program availability.

Methodologies used to disseminate information regarding the new program will include:

1. Addendum to the College catalog.
2. Spot releases to the media.
3. Notification to local schools.
4. Notification to local industry.
5. Notification to local members of the Society of Manufacturing Engineers and Associates; the Robotics International, and the Association for Finishing Processes.
6. Notification to local members of the American Welding Society.
7. Notification to local members of the Machine Tool Distributors Association.
8. Notification to private career counseling agencies.

d
11/28/83

APPENDIX A

COURSE DESCRIPTION & COMPETENCIES

NUMERICAL CONTROL I (TME 100) 3 credits - 3 hours lecture

This course provides an introduction to numerical control, including fundamental concepts, terminology and applications. Various mathematical applications for definition of movement and position are presented. The capabilities, advantages and disadvantages of numerical control equipment will be discussed. Basic Numerical Control systems will be identified. Various aspects of manual programming will be addressed. Criteria, basic to effective preventative maintenance, safety, machine set-up and operation will be covered. Upon successful completion of this course, the student should be able to:

. . . describe the historical aspects of numerical control, and production enhancement capabilities of numerical control.

. . . describe the basic concepts of numerical control operation, as well as its practical applications.

. . . apply principles of mathematics and geometric definition to describe part surface, feature locations and machine position.

. . . distinguish between absolute and incremental positioning, and discuss the concept of interpolation as it applies to machining and manufacturing.

. . . convert a part drawing to a process drawing.

. . . prepare a manual program, utilizing linear and circular interpolation to define position and movement.

. . . define the components of a programmable numerically controlled system.

. . . differentiate between an open loop and a closed loop system.

. . . describe the principles involved with machine tool activation.

. discuss the production capabilities of various numerical control machine tools.

COURSE DESCRIPTION & COMPETENCIES

NUMERICAL CONTROL II (TME 101) 3 credits - 2 hours lecture, 2 hours laboratory

A continuation of Numerical Control I, this course will place emphasis on such topics as establishment of machining parameters for increased production, and operation of numerical controlled machines and related hardware. Additional topics will include basic familiarization with computer-assisted manufacturing, machine languages and concepts involving integration of Computer Numerical Control software with standard programming techniques. Students successfully completing this course should be able to:

. . . describe the function of the various people involved in the operation of a numerically controlled machine/automated system.

. . . define and list the steps involved with part drawing analysis, tool selection, manuscript completion, computer-aided program preparation and execution.

. . . demonstrate the use of the "family of parts" concept to generate a machining program.

. . . prepare a basic computer numerical control program utilizing the "Automatically Programmed Tools" Language format and codes.

. . . list the appropriate steps for start-up, operation and shut-down of a computer numerical control machine tool system.

. . . compare and contrast the advantages and disadvantages of utilizing preset vs. qualified tooling on numerically controlled machine tools.

. . . discuss the use of fixtures in numerical control machining.

. . . identify the function of individual components of a computer numerical control system and how they integrate with each other.

. . . list the advantages and disadvantages of an in-house turn key package for program preparation as opposed to a time sharing system.

. . . demonstrate the ability to program, set-up and operate a 3-axis computer numerical control machine tool system.

. . . develop and proof a simple part program for a computer numerical control lathe.

. . . describe state-of-the-art innovations in computer numerical control programming software.

Prereq. Numerical Control I (TME 100)

COURSE DESCRIPTION & COMPETENCIES

ROBOTICS I (TME 200) 3 credits - 3 hours lecture

This course provides an introduction to the field of robotics. The specific types of industrial robots, their function, and mode of operation will be addressed. The impact that reprogrammable automation and the application of robots is having on the worker, the work place, and on production planning will be discussed. Actuation and operational characteristics of robots will be discussed. Upon successful completion of this course, the student should be able to:

. . . identify the effects that technology and industrial robots are having on employers and employees.

. . . describe the basic mechanical configurations to which robots are designed.

. . . discuss the structural and functional characteristics of various types of robots.

. . . compare and contrast robotic control systems.

. . . list the end of arm tooling characteristics available to the production planner.

. . . prepare a list of maintenance requirements for robot operation.

. . . explain the aspects of flexible applications inherent to a robot.

. . . define the areas in manufacturing conducive to the utilization of robots.

. . . determine the criteria relevant to establishment of accident prevention practices and procedures for the safe operation of automated equipment.

COURSE DESCRIPTION & COMPETENCIES

ROBOTICS II (TME 201) 3 credits - 2 hours lecture, 2 hours laboratory

Offered as a continuation of Robotics I, this course provides instruction on a robotic work cell development and the integration of microprocessor control to incorporate sensory feedback systems and metrological components into a manipulative applications system. Upon successful completion of this course, the student should be able to:

. . . describe the function and application of various metrological devices.

. . . read blueprints, circuit, and logic diagrams applicable to installing, interfacing, programming and repairing automated systems.

. . . determine the basic function of a sensory monitoring/feedback system.

. . . discuss the concepts involved with system interfacing and system control.

. . . analyze the various elements involved and prepare a plan for layout and integration of all the components in a robot work cell.

. . . interact with supervisory personnel and assist with the installation of a reprogrammable automated system.

. . . monitor the performance of a microprocessor/computer automated system.

Prereq. Robotics I (TME 200)

COURSE DESCRIPTION & COMPETENCIES

ELECTRO/MECHANICAL SYSTEMS (TEL 200) 3 credits - 2 hours lecture, 2 hours laboratory

This course provides an introduction to the theory, operation, and application of electronically actuated industrial-type automated control devices and systems. Interfacing problems are considered. Upon successful completion of this course, the student should be able to:

. . . interpret input/output and logic diagrams for control systems.

. . . construct automatic control circuits.

. . . install and calibrate transducer and sensor modules on an automated transfer line.

. . . integrate sensory devices with microprocessor controls.

. . . interface stepping motors with controllers.

. . . utilize feedback and control theory to demonstrate the operation of a closed loop servo-system.

Prereq: TEL 110 (Electronics I)

ERIC Clearinghouse for Junior Colleges
8118 Math-Sciences Building
University of California
Los Angeles, California 90024

JUL 13 1984